YLIOPISTOTENTTI - UNIVERSITY EXAM

Opiskelijan nimi / Student name:	Opiskelijanumero / Student number:

Opettaja täyttää / Lecturer fills in:

Opintojakson koodi and nimi / The code and the name of the course:	
Koodi / Code: 521340S	
Tentin nimi / Exam name: Communications Networks I	
Tiedekunta / Faculty: Information Technology and Electrical Engineering (ITEE)	
Tentin pvm / Date of exam: 16.12.2019	**Tentin kesto tunteina / Exam in hours: 3 h**
Tentaattori(t) / Examiner(s): Mika Ylianttila	**Opintopistemäärä / Credit units: 5**
	Sisäinen postios. / Internal address: **Mika Ylianttila / 9TST**

Sallitut apuvälineet / The devices allowed in the exam:

☒ Funktiolaskin /   ☒ Ohjelmoitava laskin /
Scientific calculator   Programmable calculator

☐ Muu materiaali, tarkennettu alla / Other material, specified below:

Tenttiin vastaaminen / Please answer the questions:
☒ Suomeksi / in Finnish   ☒ Englanniksi / in English

Suomenkielisessä tutkinto-ohjelmassa olevalla opiskelijalla on oikeus käyttää arvioitavassa opintosuorituksessa suomen kieltä, vaikka opintojakson opetuskieli olisi englanti. Tämä ei koske vieraan kielen opintoja. (Kts. Koulutuksen johtosääntö 18 §)

In a Finnish degree programme a student has a right to use Finnish language for their study attainment, even though the language of instruction is English, (excluding language studies) even when the language of instruction is other than Finnish. (See the Education Regulations 18 §)

Kysymyspaperi on palautettava / Paper with exam questions must be returned:
☐ Kyllä / Yes   ☒ Ei / No

Please answer to all questions, either in English or in Finnish. To pass the exam 10 points is required. No materials are allowed in the exam.

COMMUNICATIONS NETWORKS I (521340S)   16.12.2019

1. Explain briefly (6p)

   a) UDP (1 p) b) EPC (1 p) c) LoRa (1 p) d) MAC (1 p) e) CUPS (1 p) f) SBA (1 p)

2. Virtualization (7p)

   a) What are main benefits of virtualization (2 p)

   b) Explain what is NVF and VNF, and give at least two examples (2p)

   c) Discuss about management and orchestration of virtualized functions. Give some examples of the technological alternatives and tools to implement it. (3p).

3. Mobility management (8p)

   a) What is the difference between hard and soft handoff, and intercell and intracell handoff? (2 p)

   b) Why is location management important for mobility management in cellular systems? Compare location management in UMTS and LTE. (3p)

   c) What are main differences between MME and AMF? Discuss briefly their role in 4G and 5G architectural evolution. (3p)

4. Graph theory for networking and routing algorithms (9p)

   a) Explain Breadth First Search algorithm briefly. What is the time complexity of BFS? Explain why BFS does not work for weighted graphs with an example (3 p)

   b) What is minimum spanning tree of a graph? Find the minimum spanning tree of the graph in the figure by using Kruskal's Algorithm (3 p)

   c) Find the shortest path from S to D of the graph in the figure by using Dijkstra's Algorithm (show the algorithm steps in the table) (3p)